



High
Luminosity
LHC



SQXF Coil End Part Design

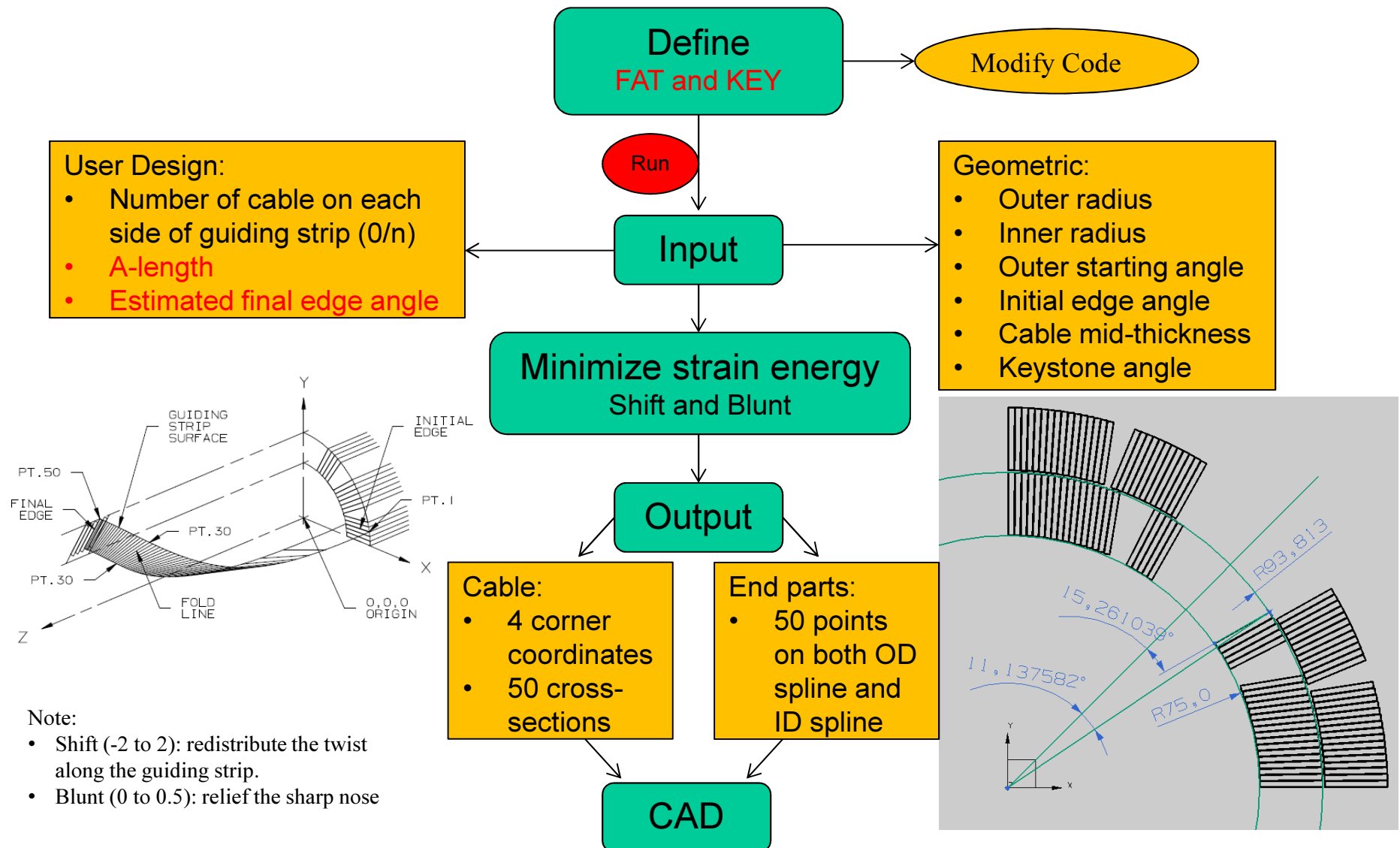
LARP-BEND

Miao Yu

05/05/2014



BEND Design Diagram





Design Parameters

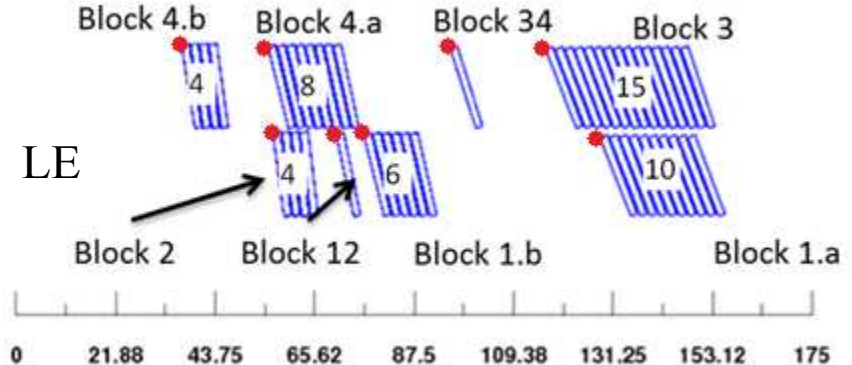
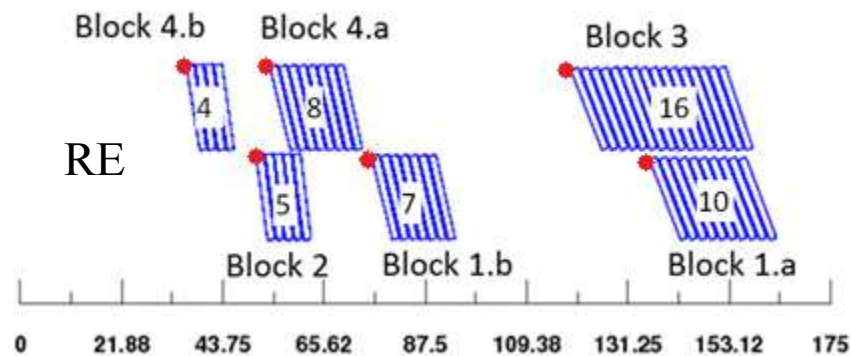


- **KEY and FAT**

- key: keystone angle; fat: mid-thickness; 1/2: midpoint/nose
- Defined based on HQ coil inspection.
- All conductor group share the same key1=0.6, key2=0.3, fat1=1.09 and fat2=1.07

- **A-length**

- Based on Roxie coil end magnetic design
- Defined to meet the first cable of each conductor group at the outer radius position

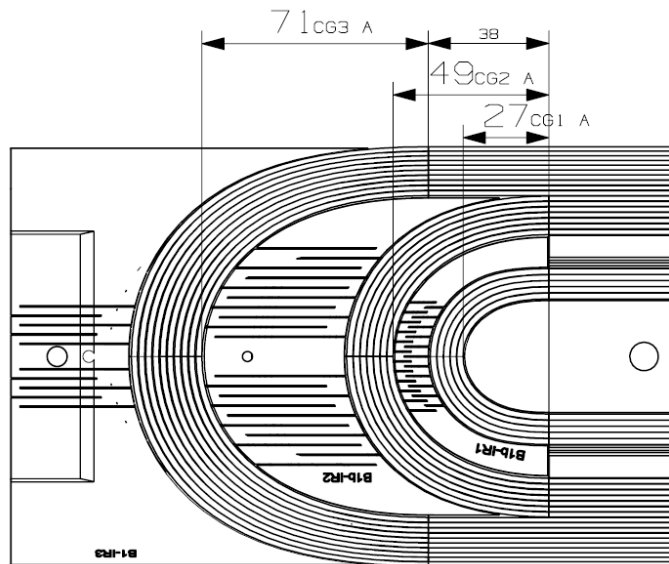


- **Final Edge Angle**

- Roughly estimate and input to BEND
- BEND automatically calculates the suggested one
- Decision by designer

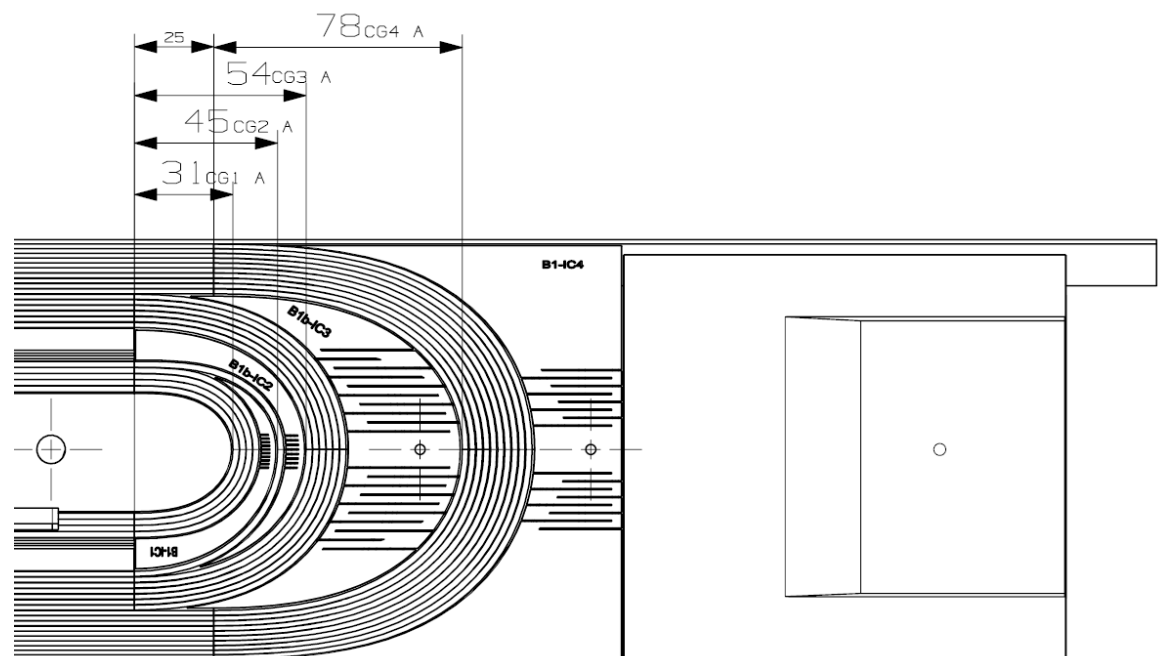


L1 A-length



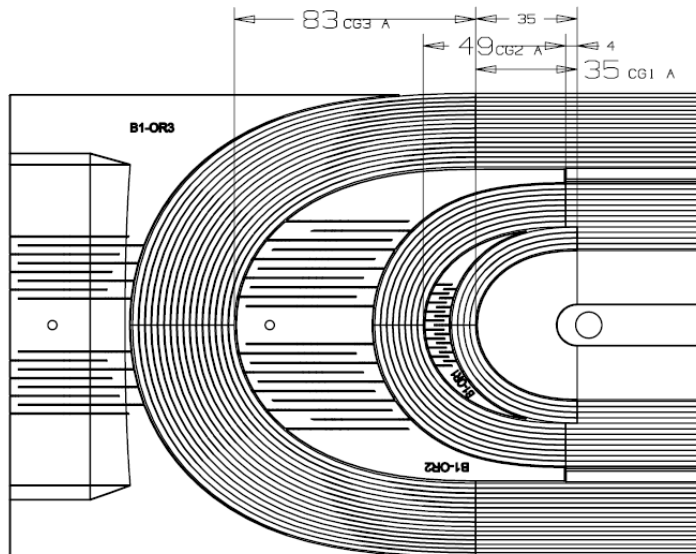
LE	CG1	CG2	CG3	CG4
A-length (mm)	31	45	54	78
Shift (mm)	0	0	0	25

RE	CG1	CG2	CG3
A-length (mm)	27	49	71
Shift (mm)	0	0	38



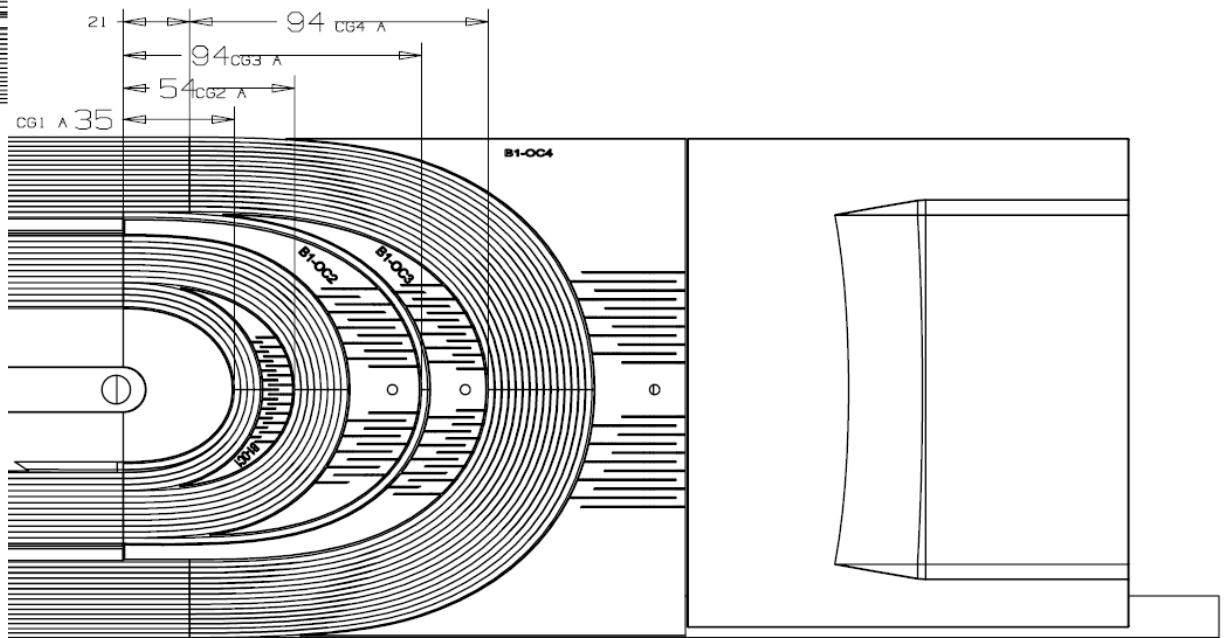


L2 A-length



LE	CG1	CG2	CG3	CG4
A-length (mm)	35	54	94	94
Shift (mm)	0	0	0	21

RE	CG1	CG2	CG3
A-length (mm)	35	49	83
Shift (mm)	0	4	35

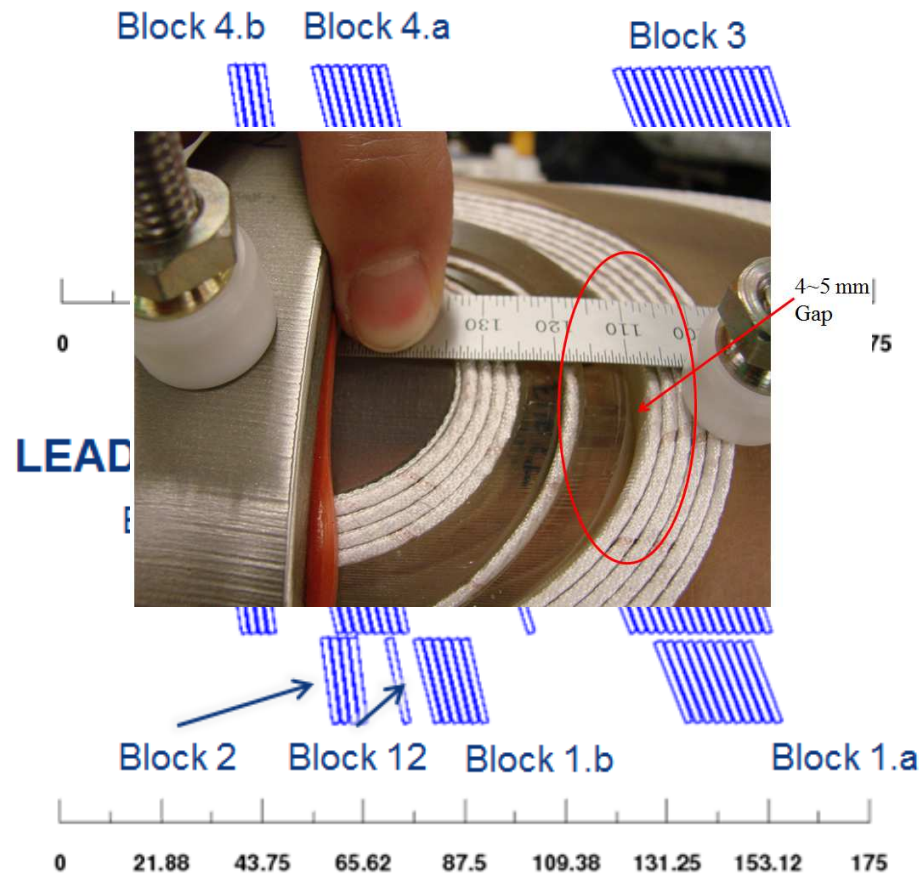




Final Edge Angle



RETURN END



	Block	ROXIE INPUT		BEND INPUT		Δ
		# cond	angle	v1	v1b	
R E	1a	10	71	25 (65)	-	6
	1b	7	76	20 (70)	14 (76)	0
	2b	5	82	9 (81)	-	1
	3	16	68.5	22.5 (67.5)	-	1
	4a	8	76	14 (76)	-	0
	4b	4	81	11 (79)	-	2

* Positive Δ : steeper at CERN

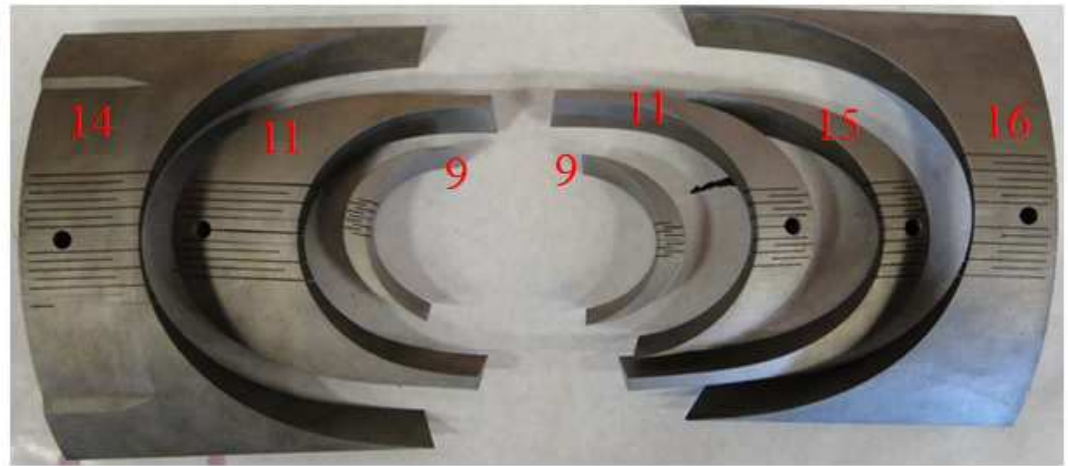
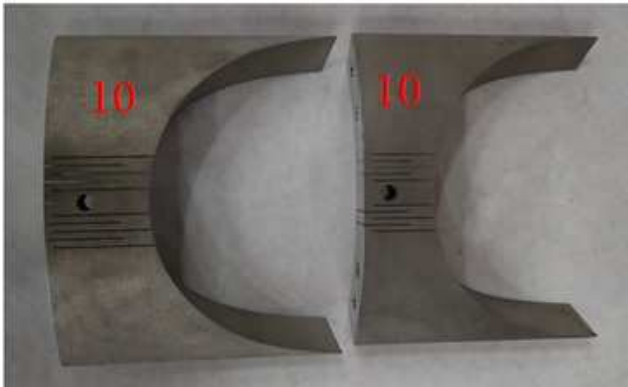
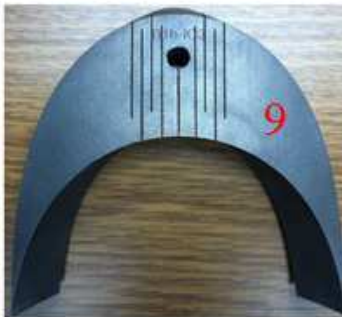
	Block	ROXIE INPUT		BEND INPUT		Δ
		# cond	angle	v1	v1b	
L E	1a	10	71	23.5 (66.5)	-	4.5
	1b	6	76	20 (70)	15 (75)	1
	1-2	1	78	13 (77)	-	1
	2	4	82	10 (80)	-	2
	3	15	68.5	22 (68)	-	0.5
	3-4	1	72	19 (71)	-	1
	4a	8	76	13 (77)	-	-1
	4b	4	81	10 (80)	-	1



Flexible End Part

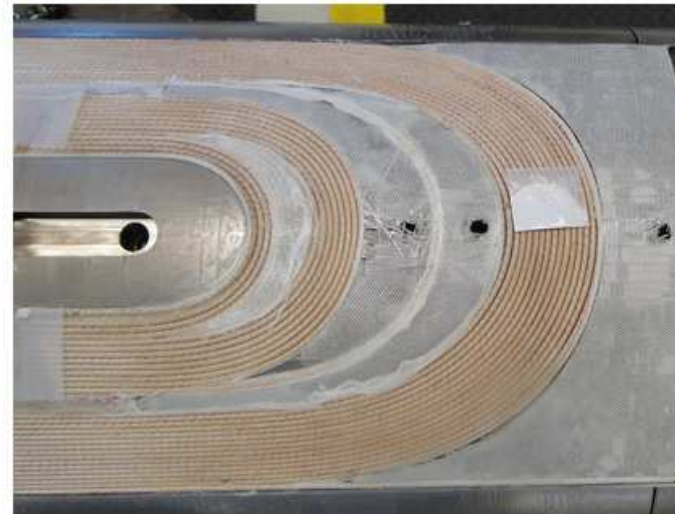
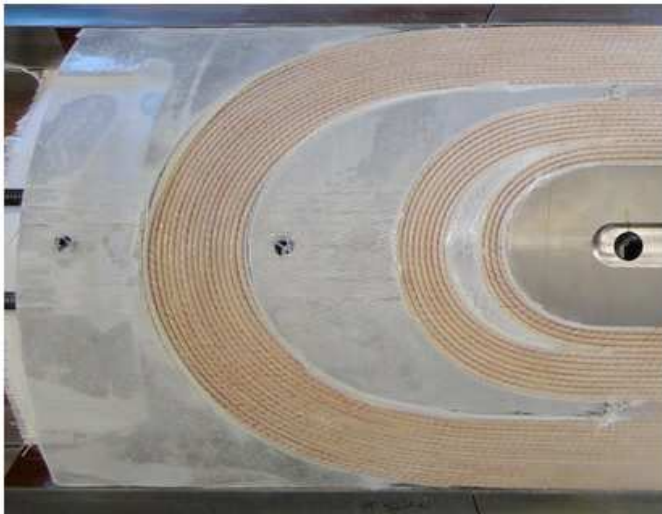
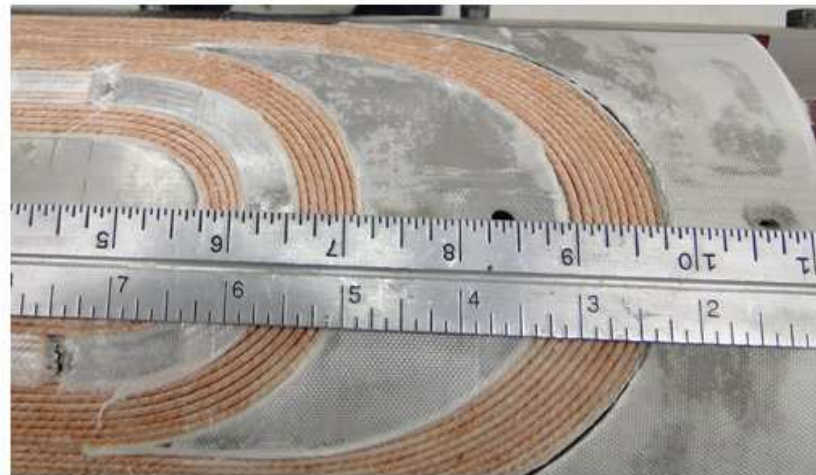


- Coil 1, LARP received the solid parts and wire cut the slits.
- Well fit the coil, although some are a little tight.



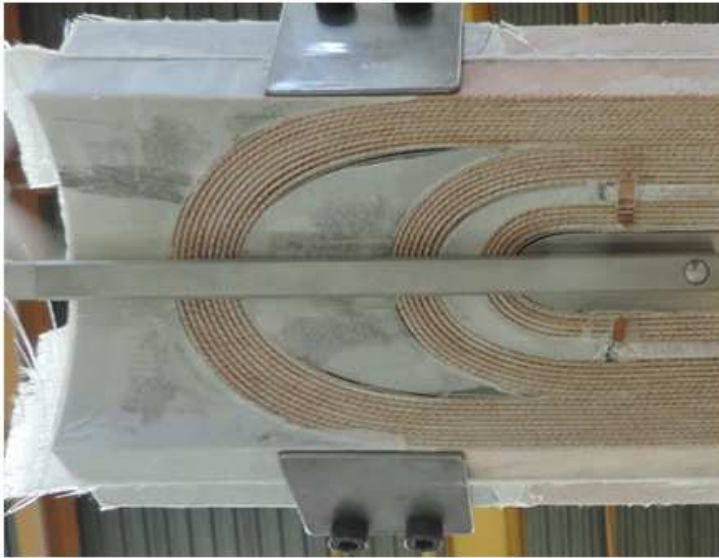


1st Practice coil after W&C





1st Practice coil after W&C





Flexible End Parts for Coil 2



- **LARP received the parts with slits and bridges**
- **We wire cut the bridges to free the needed slits.**
- **Round the edges, tips and corners**
- **Plasma Coating**



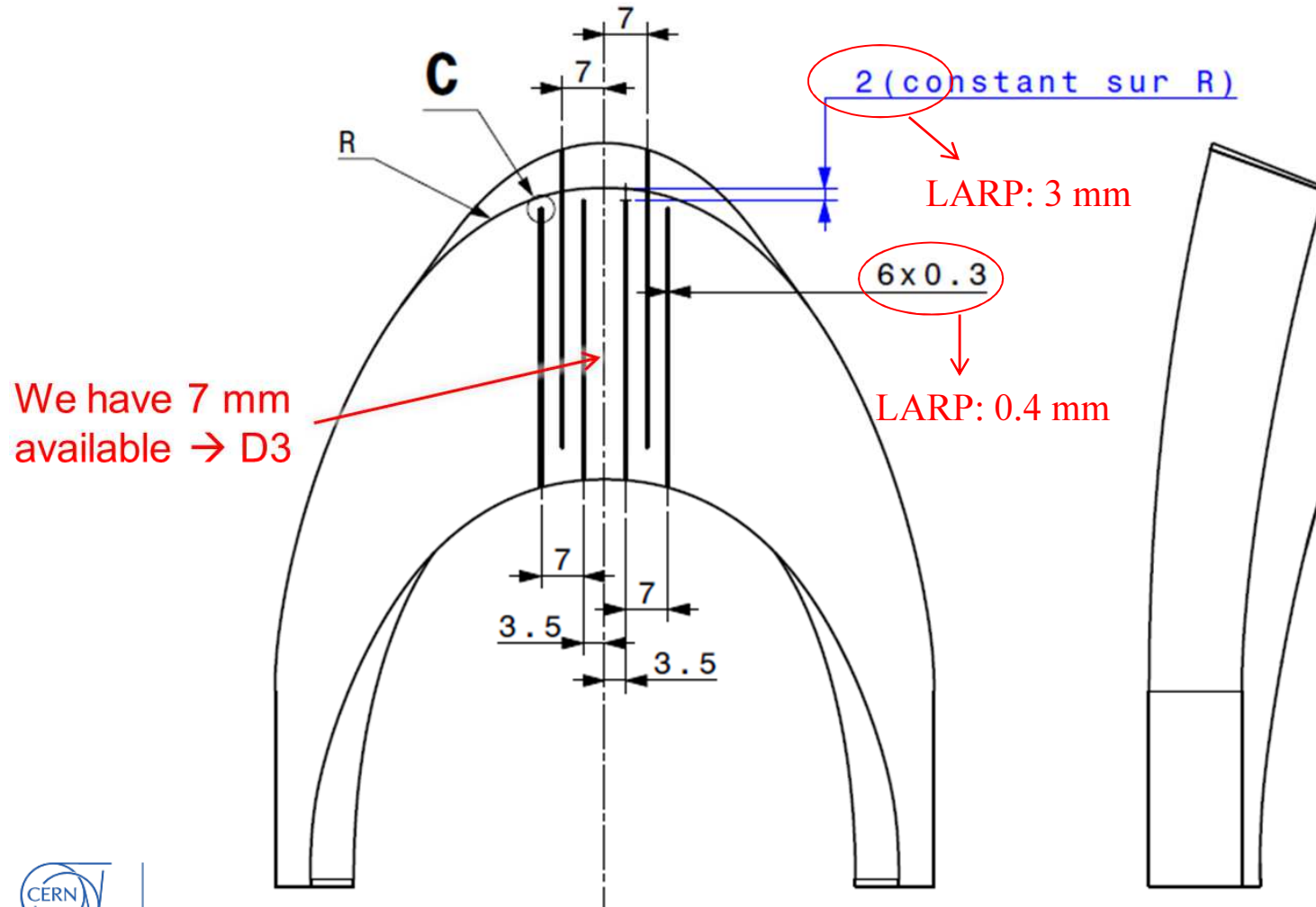
18, 14, 9, 0, 0, 14, 16



20, 14, 14, 9, 9, 14, 16

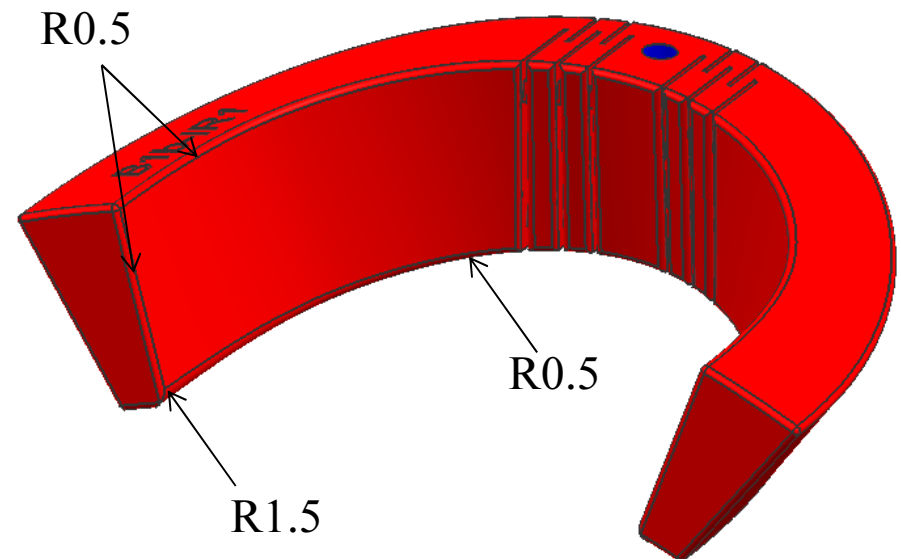
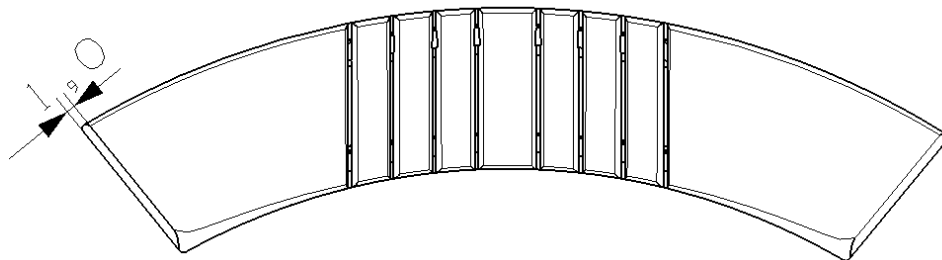
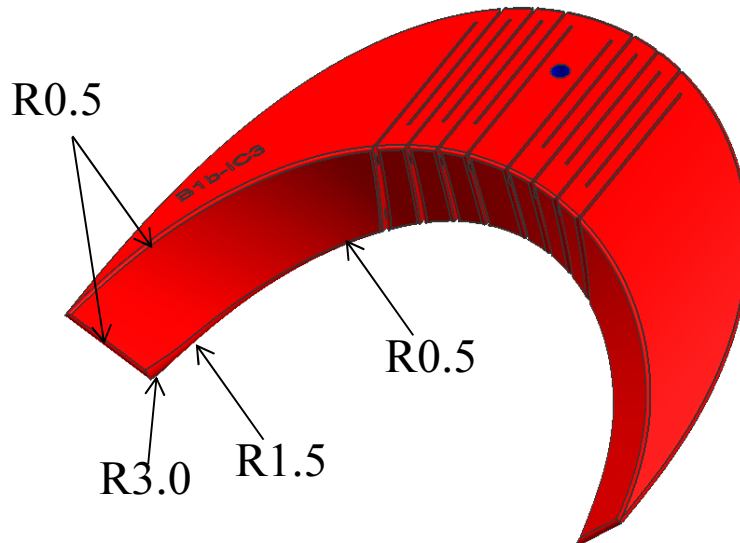


Slits Dimension



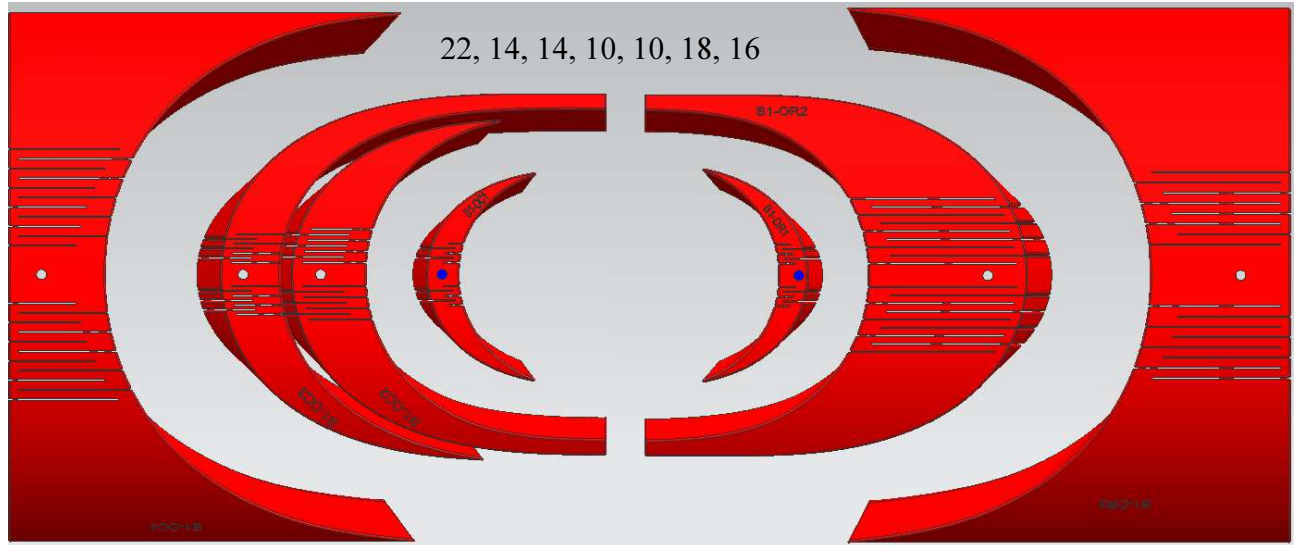
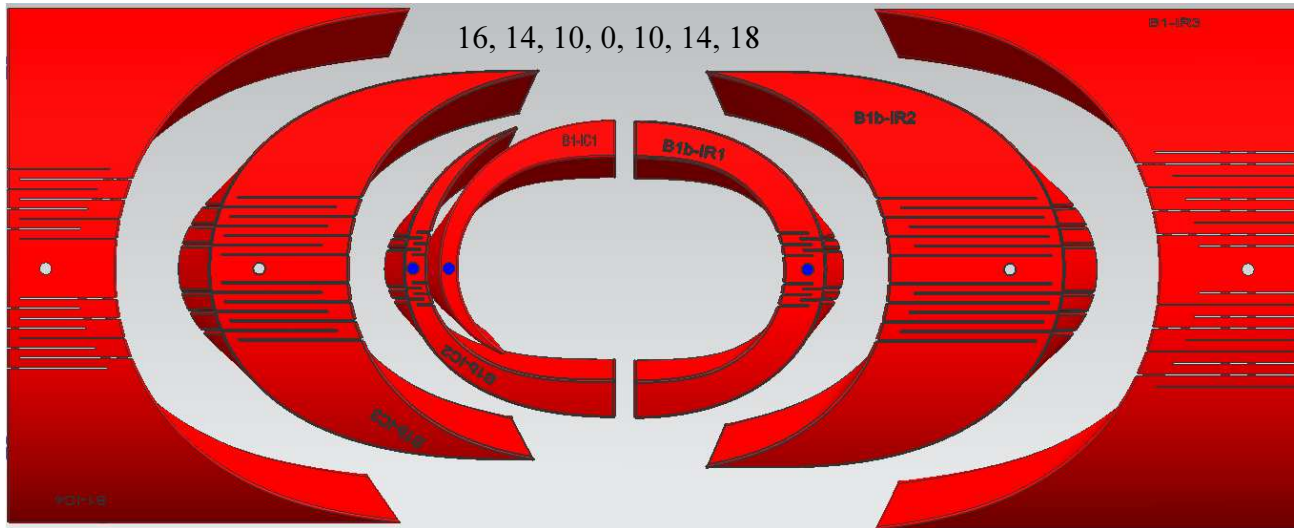


Round tip and edge





End Parts for Coil 3



- LARP received the parts with slits and bridges
- We wire cut the bridges to free the needed slits.
- Saddles w slits will be replaced after curing with the ones w/o slits.
- Each part has 3 mm pin hole for alignment during winding.
- Pin holes to connect LE saddle and its extension are abandoned. They are connected by two M6 screws.
- QA and strain relief tap holes on RE saddles are M4 size.



Slits Comparison



L1	B1b-IR1	B1b-IR2	B1-IR3	B1-IC1	B1b-IC2	B1b-IC3	B1-IC4
Coil 1	7	9	10	0	0	9	10
Coil 2	9	14	18	0	0	14	16
Coil 3	10	14	18	0	10	14	16

L2	B1-OR1	B1-OR2	B1-OR3	B1-OC1	B1-OC2	B1-OC3	B1-OC4
Coil 1	9	11	14	9	11	15	16
Coil 2	9	14	16	9	14	14	20
Coil 3	10	18	16	10	14	14	22

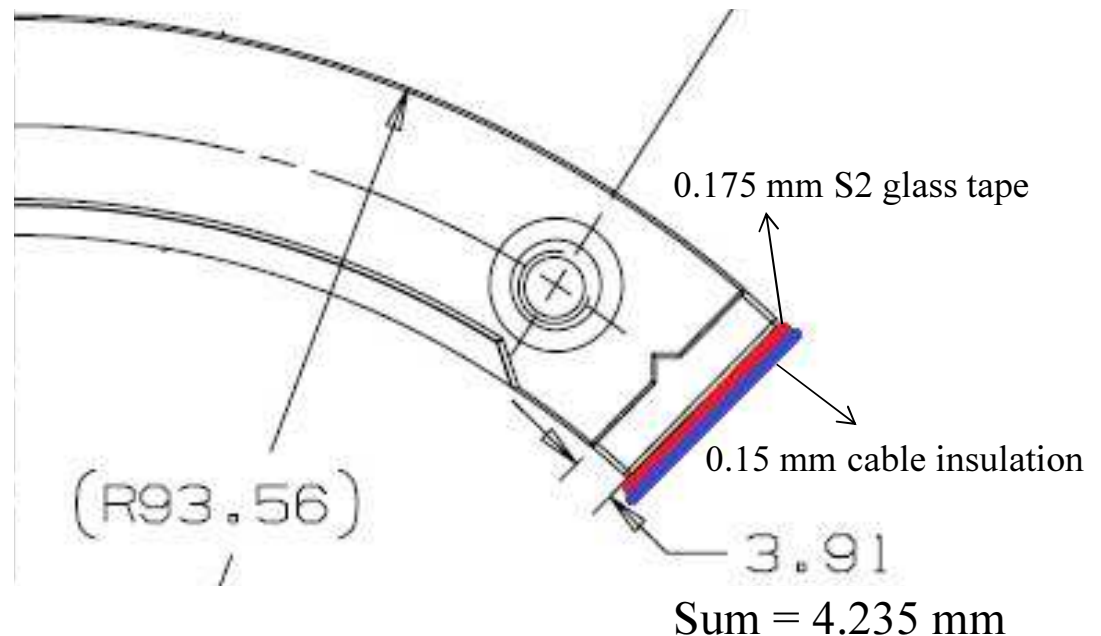
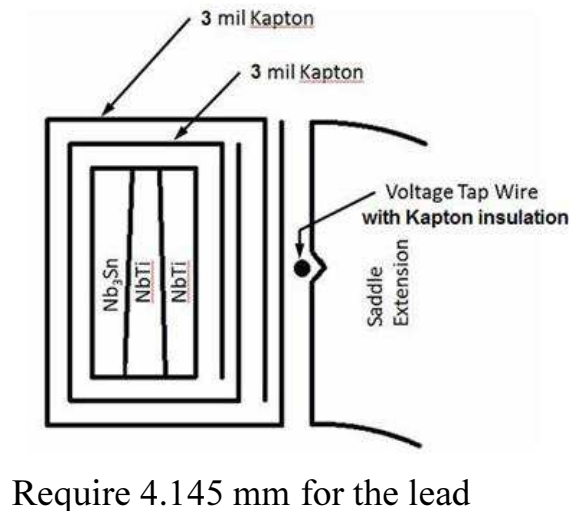
- From SQXF coil 4, the slits design will be finalized.
- The vendor will laser sintering the solid part, and then wire cut the slits.



Splice Block

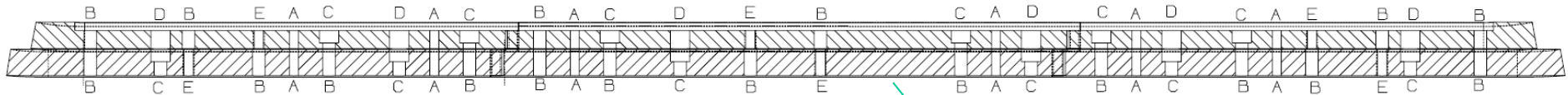
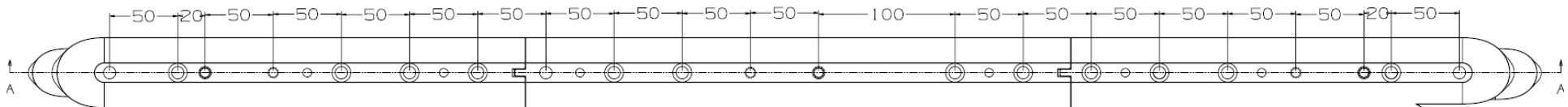


- LARP has 3 sets of splice blocks
- The splice blocks for coil 1 and coil 2 may be a little tight for the lead.
- The splice blocks for coil 3 will be modified by **offset the surface by 0.2 mm.**





SQXF Coil Pole



Pin Hole A: $\varnothing 6.35\text{mm}$ for 1/4" dowel pin
 Clearance Hole B: $\varnothing 9.0\text{mm}$ thru for 5/16" or M8 SHCS
 Clearance Hole C: $\varnothing 9.0\text{mm}$ thru, \sqcup 13.8mm, ∇ 8.8mm for 5/16" or M8 SHCS
 Clearance Hole D: $\varnothing 13.8\text{mm}$ thru for 5/16" SHCS
 Lifting Hole E: $\varnothing \text{M8} \times 1.25$ lifting threaded hole

Hole B,C,D and E will be used as cooling hole after magnet assembly

- LARP has 3 sets of poles. These poles have 6.35 mm pin hole
- From LARP coil 4, the pin hole size will be changed to 5 mm
- Except pin holes, all the other holes will be used as cooling channels



Summary



- **The current end parts design worked well on SQXF coil 1. No more optimization needed until after autopsy of coil 1 (the end of July)**
- **Number of slits will be finalized after coil 2.**
- **In stock, we have poles and splice blocks up to coil 3, and wedges up to coil 4 (more is coming soon). We will procure 3 more sets of poles and splice blocks in early June.**



AUTOPSY OF PRACTICE WINDING COILS

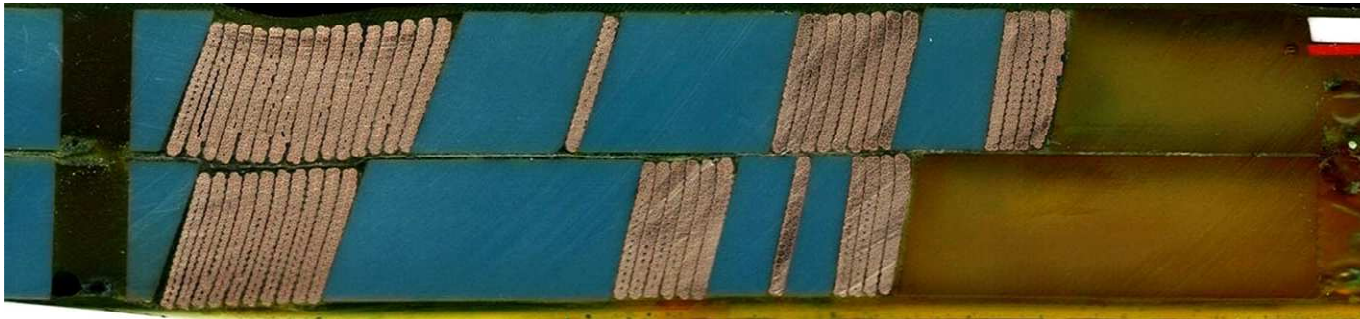


ROXIE vs. BEND at LE

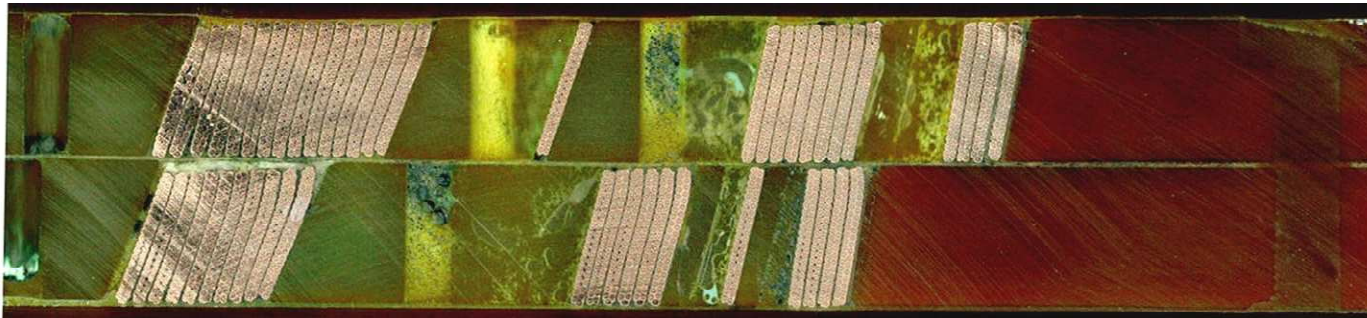


90 deg.

ROXIE
Coil 1



BEND
Coil 2



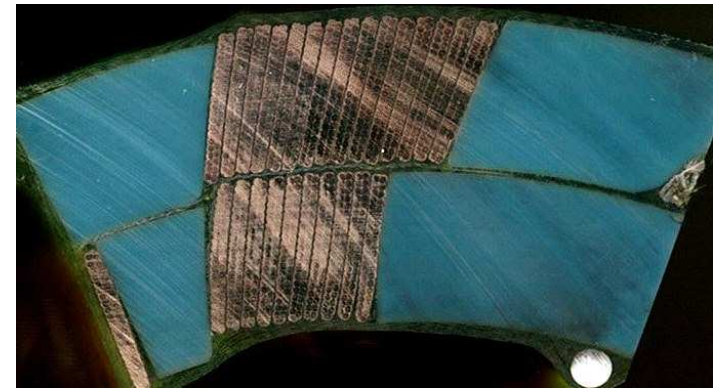
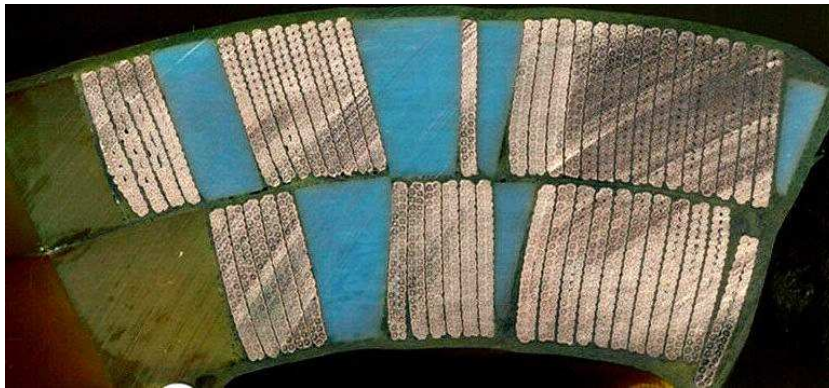


ROXIE vs. BEND at LE

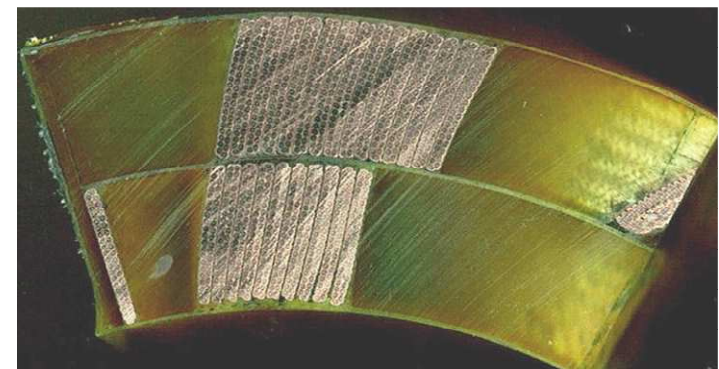
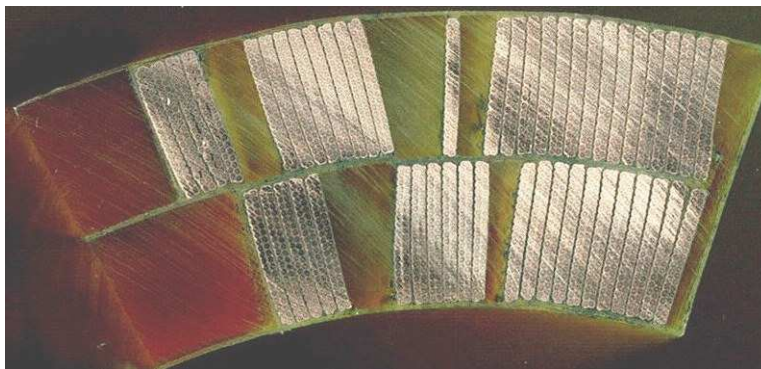


45 deg.

ROXIE
Coil 1



BEND
Coil 2





ROXIE vs. BEND at RE

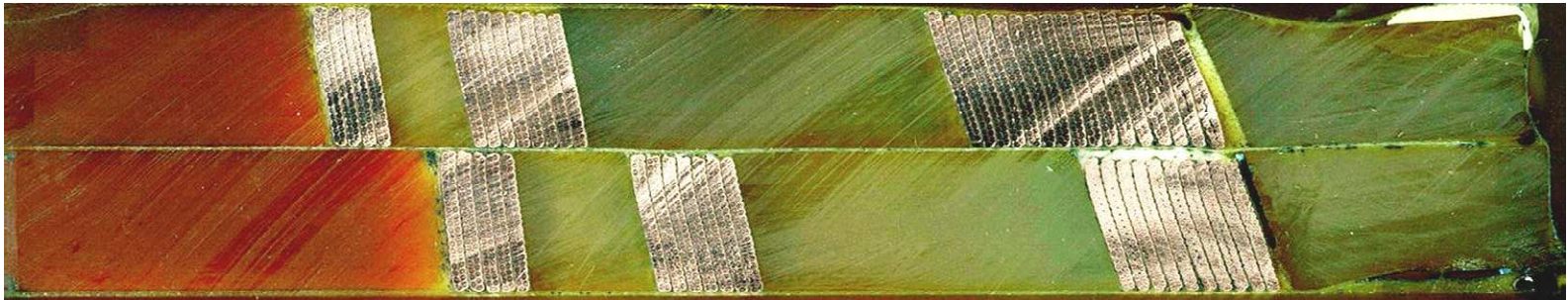


90 deg.

BEND
Coil 1



ROXIE
Coil 2



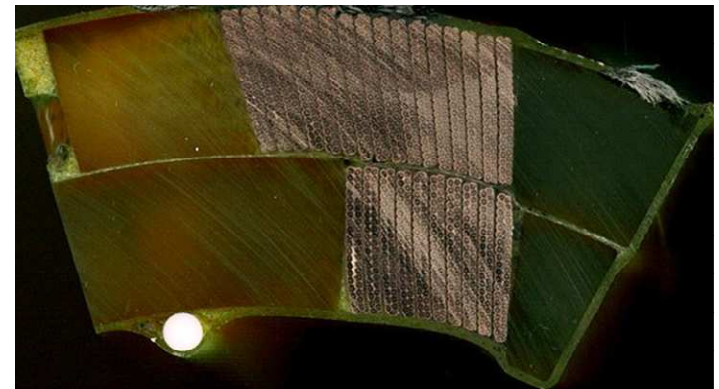
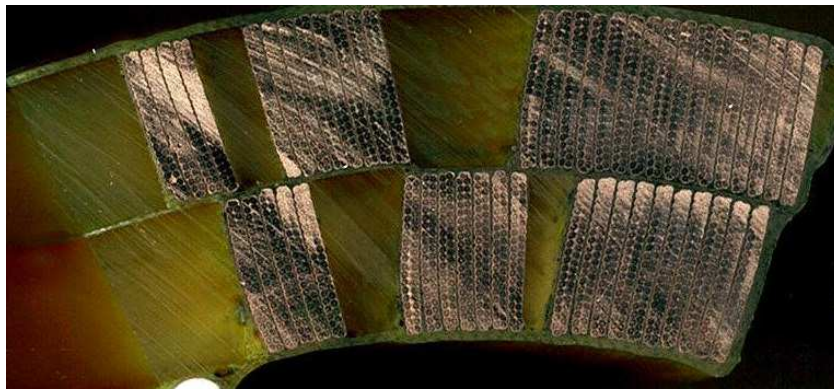


ROXIE vs. BEND at RE



45 deg.

BEND
Coil 1



ROXIE
Coil 2

